SUBMISSION ON

Climate Change Commission

2021 Draft Advice for Consultation

Vegetables New Zealand (VNZI)

20 Balance St

Wellington

Background to Vegetables New Zealand (VNZI):

Vegetables New Zealand Inc (VNZI) advocates for and represents the interests of 700 commercial vegetable growers in New Zealand, who grow around >50 different crop types and employ over 10,000 workers. Land under vegetable cultivation in New Zealand is approximately 60,000 hectares. This includes a unique set of growers who grow covered crops.

Vegetable Covered Crops

	2017		2020	
	Tonnes	**Farmgate Value**	**Tonnes**	**Farmgate Value**
Capsicum	17680	$ 91,249,289.00	18760	$ 96,724,246.34
Eggplant	1543	$ 7,918,664.00	1697.3	$ 8,710,530.40
Lettuce	3021	$ 27,000,000.00	3927.3	$ 35,100,000.00
Cucumber	18836	$ 21,367,542.00	19777.8	$ 23,504,296.20
Herb	6454	$ 27,367,542.00	8067.5	$ 34,209,427.50
Total	**47534**	**$ 174,903,037.00**	**52229.9**	**$ 198,248,500.44**

Source: Data was sourced by discussions with key growers on their crops and markets. The estimate on growth (2020 figures above) was measured as a % change from 2017 data released by NZIER

The vegetable industry value is circa $2 billion and is broken down as follows:

Total exports	Vegetable exports	$0.7bn
Total domestic	Vegetable domestic	$1.28bn

It should also be acknowledged that it is not just the economic benefits associated with horticultural production that are important. The rural economy supports rural communities and rural production defines much of the rural landscape. Food production values provide a platform for long term sustainability of communities, through the provision of food security. The essential service that horticulture provides has been further highlighted through the Covid-19 response.

VNZI purpose is to create an enduring environment where growers thrive. This is done through enabling, promoting and advocating for growers in New Zealand.

EXECUTIVE SUMMARY

VNZI supports the direction of He Pou a Rangi – the Climate Change Commission ("the CCC report"). Climate change is one of the greatest challenges facing society today and we all have a part to play in mitigating and adapting to the impacts of climate change.

It is important to get this right. A transformation to meet the 2050 target can have a positive influence on New Zealand's economy and the contribution we make globally – we need a realistic and fair transition that takes into consideration environmental, social and economic impacts, including global emissions and food security.

VNZI are at pains to point out that growers understand the need for change, they understand the need for progress, and the importance of planning change to enable our growers (and other businesses across all sectors) through the right tools, incentives and policy settings, to continue to be world leading in business practice, while reducing emissions.

Vegetable growers also understand the rationale behind the context of the 2015 Paris Climate agreement, where the climate settings can only be achieved in the considered context of producing food. New Zealand needs to protect its food security position, by feeding its people, while adapting to climate change.

With an expected population of 9.2b by 2050, and water demand expecting to rise by 55%, agriculture could account for about 70% of the increase in water[2]. To meet the challenge of population growth our farming systems will need to enhance yield production and water use to feed the population. Covered cropping systems are the natural mechanism for meeting these challenges in the future as they give increased production yields (factor of 15 increase over field grown[1]) and use 50% less water than field grown crops[2].

VNZI promotes the objective of a managed plan to achieve business resilience and climate change. This involves all parties co-designing a planned course of action to achieve climate change settings.

An international expert in glasshouse operation states, *"Optimal solutions will comprise of one, two or maybe three technologies, probably one with high investment and low operational costs that serves as a baseline, and perhaps one or two technologies with low investment requirements but with higher operational costs, to be used for a limited time each year only, for example when it is extraordinary cold. Together these technologies work together to limit both investment and operational costs. An example might be a heat pump in combination with a boiler running on hydrogen/biogas, where the latter is used on cold winter days or when electricity is pricey, and for the remainder the heat pump can do the work. Similar solutions with solar or geothermal heat are not unimaginable either."*

Critical Factors for covered crops:

1. **80% of vegetables are grown for domestic supply, 90% supply for some crops.**
2. **Lancet report indicates the importance of healthy diets, high in vegetables, for managing overloaded health systems.**
3. **Covered cropping feeds more of the world population per m2 than outdoor cropping (15x more production per unit area).**
4. **Covered cropping yields more premier produce, with 90% class 1 output, compared to field grown crops at 60% class 1.**
5. **Climate change will necessitate more covered cropping operations to feed the world population.**
6. **Covered cropping uses on average 56% less water than outdoor cropping.**
7. **Covered cropping can operate on any land use type to grow food.**
8. **Covered crops use process heat to grow food. The footprint is small at <1.0% Co2 emission.**
9. **Not all covered crops are captured in the ETS. Many growers VNZI represent grow crops (lettuce, herbs, leafy greens, chillies) not specifically identified as trade sensitive and therefore have not been able to participate in the ETS scheme.**
10. **NZ needs covered cropping to feed its population and ensure food security.**
11. **Covered cropping needs a managed plan to transition into renewable types of energy for process heat (process heat for glasshouses is 1.7% of total process heat demand in NZ)**
12. **VNZI would like to promote a managed plan for renewable energy for process heat - biogas – hydrogen – heat pump – biofuel - multiple renewable heat sources working in tandem to achieve best outcome for the region and the grower.**
13. **Gas is currently an optimal heat source for covered crops as it has a dual benefit. First, it is used to heat the covered environment for increased yields; second, CO2 from gas is captured and pumped back into the glasshouse to enhance plant growth. Gas supply needs to be considered as an option in the future, and recognised that the CO2 by-product is harnessed and used to improve operations.**

Required Actions:

- **VNZI promotes a co-design process between growers, Government and suppliers to achieve a managed plan for a resilient transition to renewable energy source for business operation and growth.**
- **VNZI promotes the need to maintain the gas infrastructure to ensure renewable gas options in the future are viable.**
- **Business resilience can only function with a stable / known political and economic environment. The capital cost of new technology has long pay back horizon. Co-design systems will help this transition.**
- **To ensure food security is preserved in NZ, there are likely to be a number of viable renewable energy sources throughout the NZ covered crop network. The best system will depend on a number of variables that feed into a co-designed plan.**
- **Covered crops have a small carbon footprint, but are determined to meet the climate change settings by adopting a managed plan for energy use in glasshouse. Each glasshouse will need a bespoke plan to manage energy efficiency and energy use.**
- **Many of the proposed alternative renewable energies are not readily available or economically viable in New Zealand. VNZI There needs to be readily available economically viable alternatives available to growers to transition to.**
- **The current ETS is not equitable for all covered crop growers. Equity of a system needs to consider both domestic and international competitive factors so not to distort the marketplace. Recognition that growers of ineligible crops (eg. lettuce and leafy greens, which are primarily for the domestic market) have for many years been paying carbon tax and received no assistance or direct financial support to change technologies. Eligible crops (usually those that are exported), such as tomatoes, eggplant, and capsicum, have had financial support via the ETS scheme. Financial support needs to be made available for covered crop growers to transition to alternative fuels and energies.**
- **Over reliance on electricity as an alternative is not taking into account the significant upgrade and capacity increase needed on current network to support growing operations.**

Use of heat in the Covered Crop sector

A recent industry survey of greenhouse vegetable growers indicates that 72% of greenhouses are heated (this is 95% of the total covered crop growing area, indicating that the majority of large commercial operations are heated).

To achieve efficiency and quality, and also ensure the viability of greenhouse vegetable production, greenhouses need to be heated. Heating has multiple functions. As well as determining the rate of photosynthesis, fruit set and fruit ripening, temperature regulates the rate of plant growth by driving transpiration rates and therefore photosynthesis rates. Heating also allows the grower to manage relative humidity in the greenhouse, reducing the onset and spread of diseases, thereby reducing the use of agrichemicals and increasing the fruit quality.

Greenhouse operations enable a grower to efficiently produce premium crops that will successfully make it to market through the ability to control the growing environment. Heating and CO2 enrichment are a crucial part of this process.

Year-round production is crucial to any successful horticulture industry. Due to the seasonal nature of horticulture, there are natural supply fluctuations that occur throughout the year. Crop production volumes decrease at the end of a season resulting in price increases. Market-share for New Zealand grown produce is then lost to alternative products or imported produce. New Zealand grown produce then has to fight to regain market share or entry back into local markets. Quite often this is achieved by growers having to accept lower prices that do not recover the cost of growing. Constant competition with imported produce sets an unfair playing field for the New Zealand grower, who is often growing to much more stringent regulatory and environmental conditions than the import country. Contributing to a higher production cost of New Zealand grown produce. Year-round production of produce in New Zealand is achieved with the help of greenhouse grown produce, evening out produce supply fluctuations throughout the year and lessen the severity of price fluctuations in the off-season. This has benefits for both growers and consumers alike.

Contribution of the covered crop industry (process heat) to New Zealand's emissions

At a national level, covered crops are a relatively small user of process heat, compared with other sectors. An MBIE factsheet from 2016 estimated that indoor cropping used 3.4 petajolues (PJ) of fuel for process heat (or 1.7% of New Zealand's total process heat demand); most of this was for low temperature (< 100º C) space heating.

In the same year, greenhouse gas emissions from indoor cropping were 220.8 kilo tonnes of carbon dioxide equivalent, or 2.8% of total process heat related greenhouse gas emissions. Process heat accounts for 27 per cent of all energy-related GHG emissions[1]; therefore, covered crops contribute less than 1% of New Zealand's total greenhouse gas emissions. The environmental gains made from water conservation and CO2 enrichment in plant production far outweigh the emissions contribution.

Covered cropping operations are located throughout New Zealand. Many operations are based close to markets in larger centres, and some places where low carbon fuels are not readily available. This is why it is crucial to look at economically viable alternatives to help growers in areas with little options.

A recent industry survey indicates that the most common form of greenhouse heating is natural gas (62% of the heated area of survey respondents), followed by coal (15%). The survey also highlighted regional differences in fuel source:

- Biogas is used by 2 business in Auckland attached to urban waste site (Redvale) that capture methane gas (biogas)
- Natural gas was limited to the upper North Island (the advice report acknowledges that there is no reticulated gas network in the South Island).
- There was one large grower in the Central North Island using geothermal energy.
- Diesel/oil heating was found in all regions, but slightly more common in the South Island.
- Biomass was only being used in the South Island.
- Only one small grower was using electricity to heat their greenhouse.

Boiler sizes range from 30 kW to 8MW (in the aforementioned survey). There is a significant range in the size of greenhouses.

International studies show there are number of energy options NZ could consider, which are renewable in full or part:

1. District Heating
2. Geothermal
3. Biomass (wood boiler)
4. Heat Pumps
5. Combined heat and power (Natural gas / Biogas)
6. Boiler (Biogas)
7. Boiler (Hydrogen)

[1] https://www.mbie.govt.nz/dmsdocument/4292-process-heat-in-new-zealand-opportunities-and-barriers-to-lowering-emissions

8. Solar heat
9. Compost Heat

Combined Heat and Power - consists of a generator running on natural gas / biogas. The generator provides electricity, which can be supplied to the grid, while the heat and CO2 are used for the greenhouse.

Each of the above energy sources have limitations based on maturity of technology and location to source. A hybrid model involving multiple technologies may assist in solving this issue. Appendix A looks at energy heat options by critical factors for implementation.

Challenges and solutions for the Covered Crops Industry

VNZI are of the view the covered crop industry does need to transition to renewable energy sources and that, over time this will be possible. However, a sufficient time period for the technology and alternatives to become available and economically viable, and support to reach this outcome will be required.

At present, VNZI consider the key barriers to change in the industry is the lack of proven and available technologies that can be practically and reliably used as an alternative furthermore, the cost of transition is a major barrier for most operators (that it is not viable). Before any grower can invest in technology it is imperative that the regulatory landscape is stable. A 10-20 year payback on capital requires macro economic and regulatory factors to be consistent and stable. Recognition needs to be given to the large number of small-medium operators who have faced financial penalties for growing produce destined for the domestic market. These growers (of crops other than tomatoes, eggplant and capsicums) have been unable to access the ETS scheme, have had to pay carbon taxes on top of fuels, and heating operation costs. These are the growers who have faced a double penalty over the past few years, but arguably have had the most incentive to have their heating technologies operating as efficiently as possible. (please reference the greenhouse survey as he made a comment about growers having significant reductions in fuel use due to better maintenance and improvements on their boilers etc)

The primary challenge facing all Covered Crops is what energy to invest in that will be optimal for 10-20 year lifespan?

An international commentator states, *"Assuming a well-insulated greenhouse that uses a minimum amount of heat, the next consideration is energy saving. To reduce the amount energy required, but the need for heat is still there, it is only much less. However, a great benefit of applying energy saving measures, is that heating systems based on lower temperatures are now much more feasible.*

Many Covered Crop business based on fossil fuels will look at electricity or biomass. The problem with solar and wind energy renewables, is that it is not a stable source. In fact it has a huge seasonal factor, and it can vary heavily from day to day, or even from hour to hour. So on the one hand you have a higher electricity demand, on the other hand you have a more instable supply. To mitigate this imbalance or instability, it could be an option to apply Combined Heat and Power for the medium term of the energy transition. I would be the first to agree that it is not durable in its essence if it runs on natural gas, but if compared to a coal fired power plant, or even a stand-alone gas power plant it is much better. A greenhouse is one of the only applications where all the outgoing streams, electricity, heat and CO2 are economically used, and from all fossil fuels, natural gas is one of the cleanest. It could be used as an exit strategy for the usage of fossils. In the meantime these generators can help to stabilise your nation's electricity grid until there is a viable alternative for them. It is not a must per se, but it could be a viable strategic option if it could be brought line with government energy policies. The same goes for heat pumps, these can also be used for grid balancing, but then these function on the demand side instead of the supply size. To prevent misunderstanding, I am not implying here that greenhouses can solve all imbalances of a nation's grid, but can contribute.

The challenges facing growers are best explained by grower statements. The attached statements show that the growers are working toward energy efficiencies in their business. What is missing in the equation is time. Time to decide on the right heat solution before the current heating resources are influenced to uneconomic use levels.

Jade Gardens

Robert Lindsay

Managing Director

Jade Garden Cucumbers is a 2 hectare covered cropping operation based in Kaiapoi, Canterbury. The business has been operating for over 30 years, and employs 18 staff. We produce in excess of 1000 tons of cucumbers per annum, all of which are sold on the domestic market.

We have hired a consultant (December 2020) who is an expert in Priva (our climate control computer) he has advised us on setpoints, to get the most benefit from our energy screens. We have seen results already in energy savings. For our twinskin tunnel houses, we have assessed them and identified zones of heat leakage (following Elly's article in NZ Grower), and taken steps to further insulate against leakage. E.g. door strips etc. We've reviewed heating setpoints in the greenhouses, and reduced them on advice from the consultant –once again seeing a reduction in energy use. We've also added a sensor on our boiler which lowers the heating setpoint as the sun's radiation increases. Thus, we don't heat the water in the system unnecessarily. That has resulted in energy savings.

We're taking steps to increase production through getting back to basics, optimising irrigation, creating the best climate for generative plant growth.

I want to scavenge CO2 from my boiler stack, but have yet to find a viable solution. Liquid CO2 has not been considered, but anecdotally, I understand it is expensive to set up, has high running costs.

Renewable energy sources: working on it. A time investment at this stage –but we're prepared to put money into this.

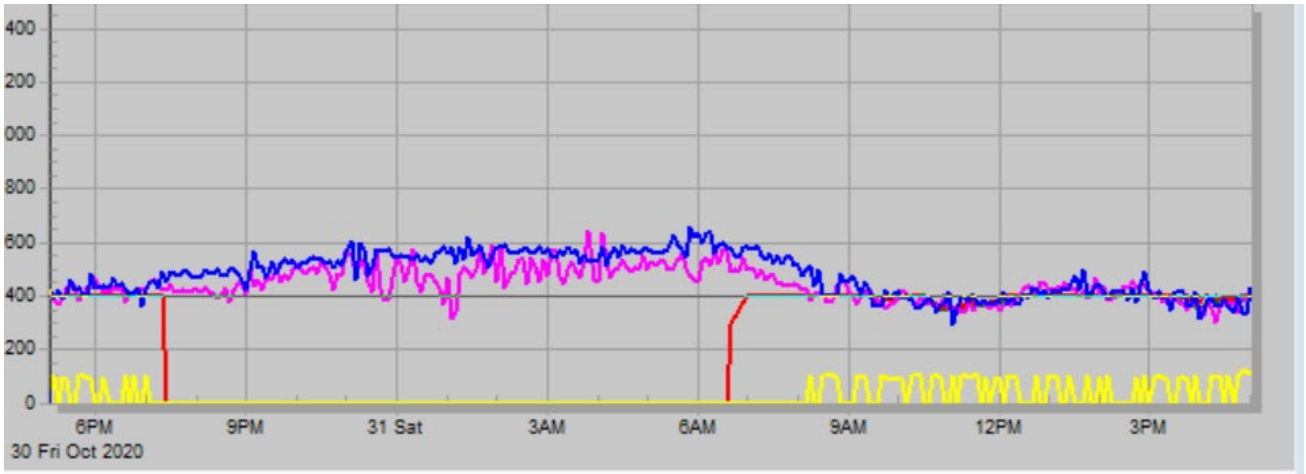
Roelf Schreuder

Production Director Protected Crops

Energy use greenhouses.

Natural gas is the main energy source used for heating greenhouse heating as it is clean and the CO2 formed is used in the greenhouse to enhance crop growth.
Screens are commonly used in our (NZ Gourmet) greenhouses in NZ and can save up to 50% energy, further savings can be made when double screens are installed.
The heating systems are all set up to run boilers for CO2 production as this is essential to our business, therefor big, insulated (buffer)tanks (up to 1200 m3) are set up to store hot water for when it is needed.
Alternatives are geothermal but no CO2 available. Drilling for hot water is expensive, over a million $ investment but depending on depth of layer with hot water.
Woodchip, CO2 can be extracted (Hot Lime Labs) but supply is short in the Auckland area and source should not be further away than 80km from the greenhouse due to transport costs. Investment of over $300k per greenhouse.
A greenhouse is a pretty much closed environment in which many crops are grown and over the years very efficient systems are developed to optimise production, quality (internal and external).
As an example, 1 ha greenhouses produces as much as 8 ha outdoor grown crops and to produce a kg greenhouse product 6 litres of water is used against outdoors 60 litres to produce the same kilo.
Other key item is that these crops use a lot of CO2 to come to these productions. Common experience is that if ventilation openings are shut, the CO2 levels go from ambient 400ppm to 200 ppm within half an hour. Greenhouse capsicum crops use 60kg CO2 per hour per ha and tomatoes 90kg per hour per ha.
For this reason, growers use natural gas to produce heat and CO2. The boilers are running during daytime until there is enough heat made to heat the greenhouse during night-time. The heat is stored in a buffer tank until it is required. The CO2 in the meantime is used in the greenhouse to supplement the natural CO2 level and making sure levels do not go below ambient.

Below a graph with normal CO2 levels in a greenhouse, due to dissimilation CO2 levels go up at night and start to drop once the sun start to shine and goes from 600 ppm to ambient within an hour. The yellow lines is when the boiler runs and replenishes the CO2, the red line is the set point for the CO2 level we like to see in the greenhouse.



Colour		Settings	Unit	Group	Factor	Axis
	☑	CO2 control: computed	ppm	S1-2	1	<-
	☑	CO2 control: computed	ppm	S3-4	1	<-
	☑	CO2 measurement	ppm	S5-6	1	<-
	☑	CO2 measurement	ppm	S7-8	1	<-
	☑	CO2 capacity: computed capacity	m^3/h	Gas Boiler	1	<-

Southern Paprika Limited

PRODUCERS OF QUALITY NEW ZEALAND CAPSICUMS

Blair Morris

General Manager

Southern Paprika is a large Greenhouse operator located north of Auckland. Currently our production is focused on Capsicum production, however we are able to convert our Greenhouse to production of many vegetable crops within a short time frame. We currently produce 7000 tonnes of Capsicums per annum for domestic and export markets Australia and Japan. We have been in business for over 20 years and employee 150 staff.

Over the years we have seen our export volume as a percentage of production drop from over 70 % to approx. 35 % export. This has been a planned move by SPL with a strong desire to be focused on domestic production for NZ communities (producing food for New Zealand). The domestic demand has also supported the move away from export with an increasing population and our scale being able to deliver Capsicums year around at a more affordable price. This has also had the impact of a steady decline in the volume of Capsicums imported to NZ from Australia and Holland which has a positive impact of global carons emissions.

The Greenhouse industry is considered a large user of Energy and we have always been looking for alternative energy as a replacement for Natural Gas as part of a risk mitigation strategy. However, as we also use the Natural Gas for Co2 enrichment in the Greenhouses, (this increases yield by 15 %) there have been no alternatives. Until recently you have not been able to take the Co2 from Biofuel burners and use it in the Greenhouses. This model is now being proved but extremely expensive and viable only with Government subsidies.

Protecting the Greenhouse industry is essential to food security. We at Southern Paprika are located within 50 minutes of Auckland meaning low emissions and cost-effective supply to NZ's largest population base.

As a company focused on only positive benefits for NZ and doing things in a sustainable manner, we ask you to consider the following:

1. A Greenhouses production is approx 30 times more productive per square meter of a field crop.
2. We operate a closed loop water reticulation process with all nutrients collected and reused.
3. Limited chemicals used due to good climate control and Biological insect control where possible.
4. Controlled environment protects reliability of supply compared with outdoor production.
5. Year-round production providing import substitution and export revenue in peak periods
6. Co2 enrichment critical to good production.
7. End of season growing material from Plants used on our Avocado operation as compost creating an environmentally sustainable benefit to additional food production for NZ
8. Scale and efficiency allow us to produce affordable produce year around, benefiting lower socio economic communities in terms of healthy food at a lower cost
9. Our facilities use the latest in European production method's and we are refining this all the time.

We used to grow field Capsicums 25 years ago but converted to Greenhouse production due to this proven efficiency of the Greenhouse and there is now very little field production in NZ of Capsicums.

Worldwide more field production of all vegetables and Salad lines are going under cover due to the aforementioned reasons.

Our use of Natural Gas is extremely efficient, and an optimal use of NZ's natural resource at over 95% conversion. Compare this with using gas to make electricity where all the heat generated is lost.

We are good steward of the resource, delivering multiple benefits in terms of production, cost efficiency, sustainability of all resources used as well as using the Co2 produced.

Vegetables NEW ZEALAND Inc

Vegetable RESEARCH+ INNOVATION

vegetables.co.nz

EXCEPTION LTD Passion Fresh Ltd

221 Buckville Road, Pukekohe 353 Harrisville Road, Pukekohe 2677

A M Van Der Houwen
Managing Director

Submission to Climate Change Commission by Exception Limited / Passion Fresh Limited

Together, Exception and Passion Fresh Limited are the largest cucumber growers in New Zealand. We are located south of Auckland, on the outskirts of Pukekohe, and have been in business since 1999.

We predominately grow telegraph cucumbers, with 7% of our site is dedicated to the production of smaller snack cucumbers. Our current produce is approximately 10 million cucumbers annually, with 99% being sent to the domestic market.

The two companies employ 50 permanent staff members and a varying number of contractors as seasons demand.

We grow cucumbers in glass houses as the New Zealand climate is too cold and variable for outdoor growth.

Natural gas is a key component in our production process, heating our glasshouses to allow year-round production, supporting New Zealand's food security.

We are mindful of reducing our energy footprint where possible, and so also use the Co2 from burning the natural gas, for Co2 enrichment. This has increased our yield by 25% (without Co2, indoor growers cannot produce economically). There are currently no economical alternatives to Co2 enrichment by burning bio-fuel or other sources.

In recent years we have introduced several measures to optimise energy usage. We conserve energy by lowering the gas exhaust temperature from approximately 100 degrees to 40 degrees. We achieved this result by installing an additional heat exchange unit behind our boiler. The surplus of heat from gas exhausts, is returned to the glass houses.

We also use horizontal energy curtains which we have found help us to save energy in the winter and spring by approximately 25% annually.

Further, we use sophisticated climate control software to continuously monitor glasshouse indicators, matching required energy inputs. This allows us to maximise energy efficiency.

Together, these measures ensure our use of natural gas is extremely efficient, with the energy conversion rate approximately 96%.

It may be that in the future there will be opportunities for natural gas (or LNG) co-generation. However, this can only be achieved with certainty of natural gas supply, and a fair per unit return on surplus energy returned to the grid.

Greg Dunn

Indoor Cropping Manager

Submission on climate change from Southern Fresh Group. 25.3.21

Southern Fresh is a primary food producer and processor for the New Zealand market located at 461 Bruntwood Road, just south of Hamilton.

We have 80 fulltime employed staff and we have an extra 50 part time workers in the busy season, tending to our crops of salads, vegetables and herbs. We consider ourselves a significant employer and contributor to our local economy.

Southern Fresh currently has an annual turnover of $21 million, with forecasted growth of 10% year on year. NZ demand for clean safe food is accelerating at a pace that can't be met by traditional farming practices. The demand for land to build residential houses on, and farming to making an impact on a cleaner environment, is all impacting on our primary food bowl. Southern Fresh crop on 200 hectares and can foresee significant challenges with the government's proposed healthy rivers mandate. This has made us at Southern Fresh look at more environmentally safer, and alternate ways of growing our salad and herb crops. Covered cropping is the way of the future for providing food for the world. This is a well-documented fact.

We have invested $6 million into a world class computerised growing environment. The glasshouse is a 2-hectare complex and we have obtained recourse consent to build another 4 hectares, so we are committed to further substantial capital investments in the next 2-3 years. The glasshouse has been installed with a modern, high efficiency natural gas boiler for heating the glasshouse and capturing the CO2 from the natural gas. The use of gas for heating and collection of the CO2 as a waste product from the burning of the natural gas is an essential ingredient required to keep the glasshouse operation

sustainable. The issue around the government's proposed agenda on reducing carbon emissions is understandably a reasonable and expected request, however, what we do have an issue with is the road map as to what the alternative fuel source is and the huge uncertainty this government is creating for business here in NZ. Below are some specific points that we wish to point out in our submission.

- Natural gas is used as a heating source and the Co2 is captured from the flue duct and distributed around in our glasshouse. The reason for this is the Co2 in the natural air is between 375 and 390 ppm. When the plants want to photosynthesize, the plants use Co2 and when this happens and there is no supplementary Co2, the level of Co2 drops down below 250ppm very quickly, especially if the vents of the glasshouse need to stay shut because of the outside temperature being below what is required. Best growth and yield production for our type of crops comes about when the Co2 can be increased to 700 ppm while the plants are photosynthesizing.

- Our glasshouse complex and our industry is unique because we are using the Co2 up to produce the food. Our industry should be entitled to carbon credits as we aren't contributing very much to the problem of waste Co2 going into the atmosphere. The ETS we pay on the gas should be reimbursed to us somehow.
- There are alternative systems for producing Co2 in the event of natural gas use being ceased, however, the timeline for the government phasing out natural gas needs to reflect in the realities that this new technology needs to be developed and proven on a commercial scale, so NZ business aren't put at risk.
- There may be viability with using the existing infrastructure for natural gas and finding alternative gases to replace natural gas, such as bio gas or hydrogen. The government needs to have a clear plan forward on the options before committing to dates to stop using fossil fuels.
- We have started looking at alternative heating systems such as a wood chip boiler and a system for producing Co2 from limestone, however, the volume of woodchip we would need on a daily basis is 3 truck and trailer loads a day, let alone the storage of the woodchip to keep it dry. There are also issues with sourcing wood chip; there won't be enough trees around the countryside by the time everyone starts burning wood. Forestry takes 25 years to grow so the government's timeline would need to reflect the time to grow sufficient forests.
- We have also looked at bio reactors, using the vegetable waste from our factory and whey from the local dairy factory, but the efficiency and effectiveness of using this as a primary source of heat isn't an option it seems at this time.
- We are following very closely the developments in photovoltaic glass in Holland, where transparent glass can work like a solar panel to generate electricity. This could be a very feasible option in years to come but photovoltaic glass is still in development stages.

- The alternative fuel sources (i.e., hydrogen, biogas) needs to be at a competitive price, so NZ growers aren't at risk from overseas importation of vegetables.
- Any existing fuel system that uses coal or natural gas needs a system of government funding to facilitate the capital requirement to make the change to an alternative fuel source.

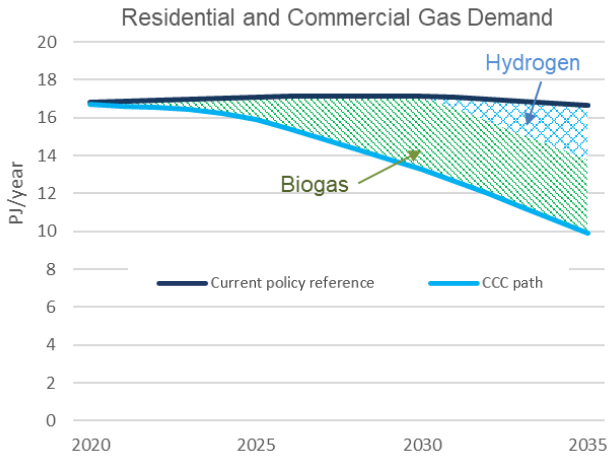
So, in conclusion in principle, we agree with the need to reduce emissions, but we don't agree with appointing end dates of gas supply until the government has a strong watertight plan to produce alternatives. We are very concerned that so much hinges on the government getting this process correct. The messages and communication needs to be clear and backed up with alternatives so that NZ businesses, and ultimately, its people are kept in employment, and just as important, that we have something to eat going forward.

Please feel free to reach out and discuss, until then, kind regards.

Pat Dunn	Jeremy Dunn	Greg Dunn
Southern Fresh	Southern Fresh	Southern Fresh

FirstGas Group, with the support of VNZI, promote the need for a managed plan for natural gas use over time. The critical point in this consideration is to preserve the viability of the gas infra-structure to enable a managed phasing of renewable gas (Biogas / hydrogen) as the technology is available[4].

Table 2. Gas supply potential 2020 – 2035.



FirstGas and VNZI believe that low carbon gases are technically and economically viable to help achieve the carbon budgets.

- Natural gas needs to be considered as part of a strategic transformational plan.
- Biogas is technically and economically viable today [evidence: Beca study on biogas feedstock availability]

- Hydrogen provides a valuable option for New Zealand's long-term energy transition [evidence: Firstgas hydrogen trial study]
- Bio-LPG can be rapidly deployed in New Zealand to decarbonise [evidence: LPGA work on bio-LPG]

Together these options can contribute to the reduction in natural gas use that is highlighted in the Commission's draft advice.

Rather than just relying on electricity; biomass, biogas and hydrogen can make a meaningful contribution to displacing natural gas use to decarbonise heating.

VNZI supports FirstGas in its belief that it is vital to continue to use gas infrastructure and appliances, as it safe guards the use of biogas and then hydrogen.

- It helps to fund the infrastructure required to meet other uses of gas that the Commission acknowledges will need to continue for decades to come (such as high temperature process heat and electricity peaking and dry-year cover) [evidence: Oakley Greenwood report]
- It promotes consumer choice. We know that consumers value their gas connections and appliances for a range of different reasons and purposes (controllable flame cooking, instantaneous water heating that never runs out) [evidence: Oakley Greenwood report]
- It minimizes stranding and replacement costs. By decarbonizing gas fuels, this will avoid the cost of replacing or displacing existing gas infrastructure as well as household internal plumbing and appliances [evidence: Oakley Greenwood report]
- It increases energy system resilience. One of the key strengths of the New Zealand energy system is its diversity of supply sources and distribution channels. This is worth preserving. [evidence: Oakley Greenwood report]

References:

1. P. Padmanabhan, ... G. Paliyath, in Encyclopedia of Food and Health, 2016
2. www.sciencedirect.com, Modes of greenhouse water savings Nolan O'Connor, Khanjan Mehta*
3. Pers comm - Arend Verboom <av@gakon.nl
4. FirstGas Group - Hydrogen Feasibility Study – Summary Report 2021

Appendix A.

Table.3.

Review of energy heat sources and critical factors for implementation.

Arend Verboom 5-3-2021

	District heating	Geothermal	Biomass (wood)	Solar heat	Heat Pumps	CHP (Natural gas)	Boiler (Natural gas)	CHP (Biogas)	Boiler (Biogas)	Compost Heat	Boiler (Hydrogen)
Maturity	Mature	Technology is available, but long term effects on the environment are to be evaluated	Mature	Experimental	Mature	Mature	Mature	Mature	Mature	Experimental	To be developed
Sustainable	Depends on source	Yes	Yes, as long the source is sustainable	Yes	Yes, as long as renewable energy is used	No	No	Yes, as long the source is sustainable	Yes, as long the source is sustainable	Yes, as long the source is sustainable	Yes, as long as renewable energy is used
Additional CO2 required	Yes	Yes	No	Yes	Yes	No	No	No	No	Maybe	Yes
Applicable CO2 system	CCS or technical	Fluegass with technical CO2 injection, technical CO2	CCS	Techninal CO2	Techninal CO2	Flue gas	Flue gas	Flue gas*	Flue gas*	Flue gas*	Technical CO2
Electricity usage	Low	Medium	Low	Low	High	None	Low	None	Low	Low	Low
Electricity generation	No	No	No	No	No	Yes	No	Yes	No	No	No
Possibilities to combine into a smart energy grid	None	None	None	None	Could be used as a balancer on the demand side. If too much power available, the heat pump could convert electricity efficiently into heat, and store it in a buffer for later use	Could be used as a balancer on the supply side when there is a electricity shortage		Could be used as a balancer on the supply side when there is a electricity shortage			
Special grid requirements	None	None	None	None	Sufficent grid capacity is required	Sufficent grid capacity is required	None	Sufficent grid capacity is required	None	None	None
Requires hot water buffer	Not required, but could be interesting	Advisable	Yes	Yes	Not required, but could be interesting	Preferably	Preferably	Preferably	Preferably	Yes	No
Investment costs	Low	Very High/High	High, with CCS very high	?	High	Very High	Low	Very High	Medium	Medium	Low
Operating costs	Depends on source	Low/Medium	Depends on source	Low	Low	High, but you can sell the electricity	High	High, but you can sell the electricity	High	Low	High
Comments								Possibly flue gas must be treated or CCS must be applied	Possibly flue gas must be treated or CCS must be applied	Possibly flue gas must be treated or CCS must be applied	